CASE STUDY

SunPower

Top global PV (solar) manufacturer increases output by approximately 40% through automation and smart manufacturing with Lighthouse Systems

EXECUTIVE SUMMARY

SunPower is a leading and innovative supplier of Solar PV Modules. In 2016, it provided the technology that powered Solar Impulse 2, the zero fuel airplane, on its record-breaking fly around the world. To respond to the challenges brought about by an explosive market demand and falling solar panel prices, the Company has turned to automation and smart manufacturing. The opportunity for change came with the build of a brand new factory in Ensanada, Mexico. The manufacturing system combining smart equipment, improved processes, high degree of plant automation and MES software delivered on traceability and compliance requirements as well as on efficiencies. Capacity per Line doubled and overall cost/watt reduced by approximately 6%.

AGGRESSIVE GROWTH COMES WITH ITS OWN CHALLENGES

SunPower has led the way with record-setting solar technologies and innovative solar solutions for over 30 years. The Company has multiple plants worldwide, some dedicated to the manufacture of PV cells and others to the assembly of finished products, also called modules.

In the last 10 years, the Company has hugely benefitted from the increasing popularity of renewable energy sources that are outpacing conventional energy sources. Around the world, individual homeowners and big corporations are turning to solar power. But explosive growth comes with its own challenges.

Competitiveness of the solar PV market

Between 2005 and 2015, the global solar PV market has grown 10 times over, with China, Japan and the United States being the fastest growing geographies. Three drivers account for the global success of Solar: environmental regulations geared to cutting CO2 emissions, Government support schemes and cheaper prices to consumer. In the last 5 years alone, panel prices have fallen by as much as 60%.

SUNPOWER®

> "Shopfloor-Online MES empowers the machines with intelligence so they know what they have to do."
>
> **Nikhil Padhi,**
> Manufacturing Project Manager

The innovation imperative

As Solar PV becomes mainstream, it is really important for SunPower to introduce new products at a faster pace, to address different geographies as well as different customer segments.

Twofold traceability requirements: 25 year warranty and tax compliance

Whether in residential, commercial or public applications, solar panels are long-term investments. Owners must be confident their solar PV installation can produce the expected wattage. With a 25-year Combined Power and Product Warranty attached to each panel sold, there is no room for errors. In the event of a warranty claim, SunPower must be able to trace issues throughout the supply chain back to the supplier of the raw material and this, for the whole duration of the warranty. If more benignly a customer or an installer enquires about the metered power of a PV panel, SunPower needs to provide that information quickly and easily.

In the USA, manufacturers must also comply with import duty rules. In the case of SunPower, a PV module may contain solar cells sourced from various countries. To calculate the import duties it owes, the Company must know exactly the country of origin of each cell in every solar panel that leaves its premises.

With a high rate of New Product Introduction (NPI), SunPower is positioned as an innovative player with a strong focus on quality. But with cost of PV modules continuously falling, it is a tall order to stay competitive, compliant and innovative at the same time. In recent years, SunPower implemented cost reduction plans, such as setting up plants in low-cost locations. However, with operations still largely manual and competition continuing to intensify, the Company found these measures insufficient.

SunPower had already seen the benefits of using MES software to meet its traceability and compliance requirements. As it was planning for a new assembly plant in Mexico, the Management decided it was now time to leverage the new opportunities offered by the combination of high degree of plant automation and MES software.

SUNPOWER ENSENADA:
AUTOMATION + MES = SMART MANUFACTURING

SunPower set up a cross-functional team and embarked in the process of redesigning its manufacturing system to take full advantage of automation, with a view to deliver ROI within 12-18 months. MES software would play a central part in making plant operations smarter.

Setting out the business objectives

The general objective was for the future factory to produce about 3000 high quality modules, i.e. 1 Megawatts per day, at full capacity. How would the Company ensure it would achieve this however? From the onset, it quantified targets in terms of throughput, Capacity per line, Reduction in Direct Labor and Cost / Watt. The design of the solution would need to deliver on these goals.

Defining which processes to automate

To assemble a module, PV cells of similar power output are soldered into string of cells, which are then placed in a matrix structure. In the next step, the structure is laminated and fitted in a weatherproof frame. In the last stage, each module is tested and rated, based on its electric output and cosmetic aspect.

Choosing the processes that would be automated was a crucial step. To do so, SunPower classified these based on their cost and quality impact. Processes involving the highest level of manual labor, or involving decision-making, and thereby risk of error, as well as the processes most prone to defects were prioritized.

Choosing a partner to deliver the MES software application

The MES software application would be the brain of the smart manufacturing operations. It would need to integrate seamlessly with the PLCs, various devices throughout the lines and Oracle ERP. It would need to offer scalability at minimum investment so that new lines could be added at low cost, and be easy to learn and master.

"The MES system needed to fit into the overall design, be able to support quick fire implementation, be within budget and easy to learn. We chose Shopfoor-Online from Lighthouse Systems, which we already used in other plants, as it met these requirements well", says Nikhil Padhi, Manufacturing Project Manager in charge of key initiatives across the plants.

ABOUT SUNPOWER

SunPower is a global leader in solar innovation and sustainability. With more than 30 years of experience, SunPower delivers highly efficient and reliable solar technology for residential, commercial and power plant customers. Their unique approach emphasizes the seamless integration of advanced SunPower technologies, delivering complete solar solutions and lasting customer value. SunPower is headquartered in Silicon Valley and has dedicated, customer-focused employees around the globe. They are majority-owned by Total, the fourth largest publicly-listed energy company in the world.

Besides the Ensanada plant in Mexico, SunPower leverages the benefits of Shopfloor-Online MES at four other assembly plants.

The MES Solution

To achieve the degree of automation desired, the MES had to be embedded deep in process. This has been enabled through a constant dialogue between the MES and the machines, via automated scanners and sensors fitted where necessary on the equipment.

Architecture

The solution is built on a four-tier architecture: PLC, OPC, MES, ERP. The MES integrates seamlessly with the machines via an OPC Server from Kepware and captures the machine transactions automatically with as little manual intervention as possible. Oracle being the ERP consolidates all the manufacturing data for costing, reporting etc. Nikhil Padhi, Manufacturing Project Manager worked closely with Lighthouse Systems to design this architecture.

Data Management: seamless communication between product management, sales, procurement and production

Master Data like SKUs & Bill of Materials (BOM) are maintained in the PLM tool. The ERP holds the Work Orders and inventory data. For completion of orders, the master data is downloaded to Shopfloor-Online: SKUs, BOM, inventory and work orders (WOs). Separate WOs are released for Finished Goods (Modules) and Work in Process (String & Laminates) to have better control over material consumption and traceability.

Shopfloor-Online generates serial numbers for each panel. As the Module progresses through the assembly line, the MES identifies it automatically via its serial number and records transactions for each process step completed at the station. All incoming inventory such as cells and solder paste that is bought and consumed is labelled and traced in the MES to ensure full lots traceability.

Once the module reaches the end of the line, it is palletized and the pallets are sent to the truck. As the pallets are completed, information is sent back to Oracle for inventory reconciliation, cost/watt calculation and generation of financial statements. Pallets are shipped out of Oracle Warehouse management system using the hand held mobile device.

Supporting the manufacturing system

The factory runs 24/7, 365 days a year and with such a high level of integration between the different layers of the system, the MES software is a critical application. Lighthouse Systems is therefore providing 24/7 support to the SunPower team.

BENEFITS OF AUTOMATION AND MES

Costs reduction and improved capacity

Some steps still require operators: for loading raw materials on to the machine, for visual inspections at the last stage and, for responding to critical faults and rework. Some transactions, especially tests are fully automated.

With smart manufacturing, improved processes and smart equipments, SunPower could reduce direct labor by about 40% from what it was in a manual operations setting and throughput time by about 40%.

> These improvements resulted in a reduction of the cost/watt by 6%, thereby directly improving the bottom line.

"Automation is often associated with job losses. But at Ensanada, thanks to a robust training programme, there was practically no job loss as workers were re-deployed to new lines", comments Nihkil.

Reduced risks of warranty claims

The mandatory pass / fail test as well as the classification test to measure actual power no longer require human intervention. As a module is tested for power classification, in what is called a Flash test, the MES knows which power output should be measured based on the solar cells used in its assembly. If the test however returns a different power output, the MES automatically reclassifies the module based on its actual power and usage (commercial or residential).

Possible human errors have been removed from this critical stage.

All the performance data for each panel is stored in the MES. That data is sent to Oracle for publication to the SunPower portal, where it is available to distributors and installers.

The system gives full traceability of modules and raw material based on the module serial number. In case of a defect in a module, SunPower can track the fault through its production process and all the way back to suppliers.

Compliance with confidence

The degree of traceability offered by the MES gives SunPower Ensanada confidence that it is compliant with US import duty rules at all time.

Increased agility for New Production Introduction (NPI)

With Shopfloor-Online MES seamlessly integrating with the PLM tool and Oracle E-Business Suite, SunPower has become more agile when it comes to launching new products. The MES manages to the smallest details how the product is made. It downloads BOMs from Oracle and as each panel is assembled, every component is qualified, including the solder paste and screws. Shopfloor-Online makes it easy to configure a new product for production, and changeovers are quicker.

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Lighthouse

Lighthouse Systems is a world-leading vendor of MES/MOM systems with offices in the UK, Singapore, the USA, France and the Nordic Countries, Poland and the UAE.

Lighthouse Systems' **Shopfloor-Online**TM is a smart manufacturing enabler. It creates the connectivity previously missing throughout manufacturing operations and provides real time visibility of the entire manufacturing operations environment. At the right time, anywhere. With Shopfloor-Online people can work smarter and assets can work harder, whilst delivering superior quality to customers and controlling costs.

The software is modular, with functionalities across all four areas of plant operations, production, quality, inventory and maintenance. It can be hosted on premise, in the corporate data centre and in the Cloud.

For more information please contact one of out offices or visit www.lighthousesystems.com

EUROPE / MIDDLE-EAST

Crawley (UK) (Head Office)
Telephone: +44 (0)1293 605 300
info@lighthousesystems.com

Paris – St Lazare (France)
Telephone: +33 1 78 42 36 12

Nordic Countries
Telephone: +46 1612 0130

Dubai (UAE)
Telephone: +971 (0)4 4272172

NORTH AMERICA

Fairport, NY (USA)
Telephone: +1 585 223 0600

ASIA

Singapore
Telephone: +65 6316 4370